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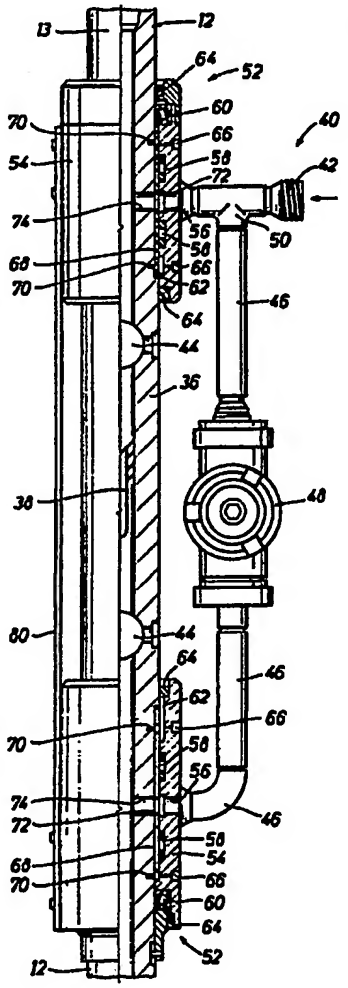
(54) Top drive cementing manifold

(57) A well string top drive cementing manifold (40), can be maintained stationary as the drill string (12) is rotated by a top drive assembly. The manifold facilitates the pumping of a cement slurry into the well and the subsequent delivery of a cementing plug (38). The manifold is mounted to the well string by a pair of swivel joints (52) which allow the continuous introduction of well fluids but allows the manifold to be held stationary as the well string is rotated. A series of valves (44) in the manifold and string direct the well fluids through the desired path. Each of the swivels incorporate bearings and seals to facilitate rotation yet maintain proper fluid flow.

FIG. 2



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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

FIG. 1

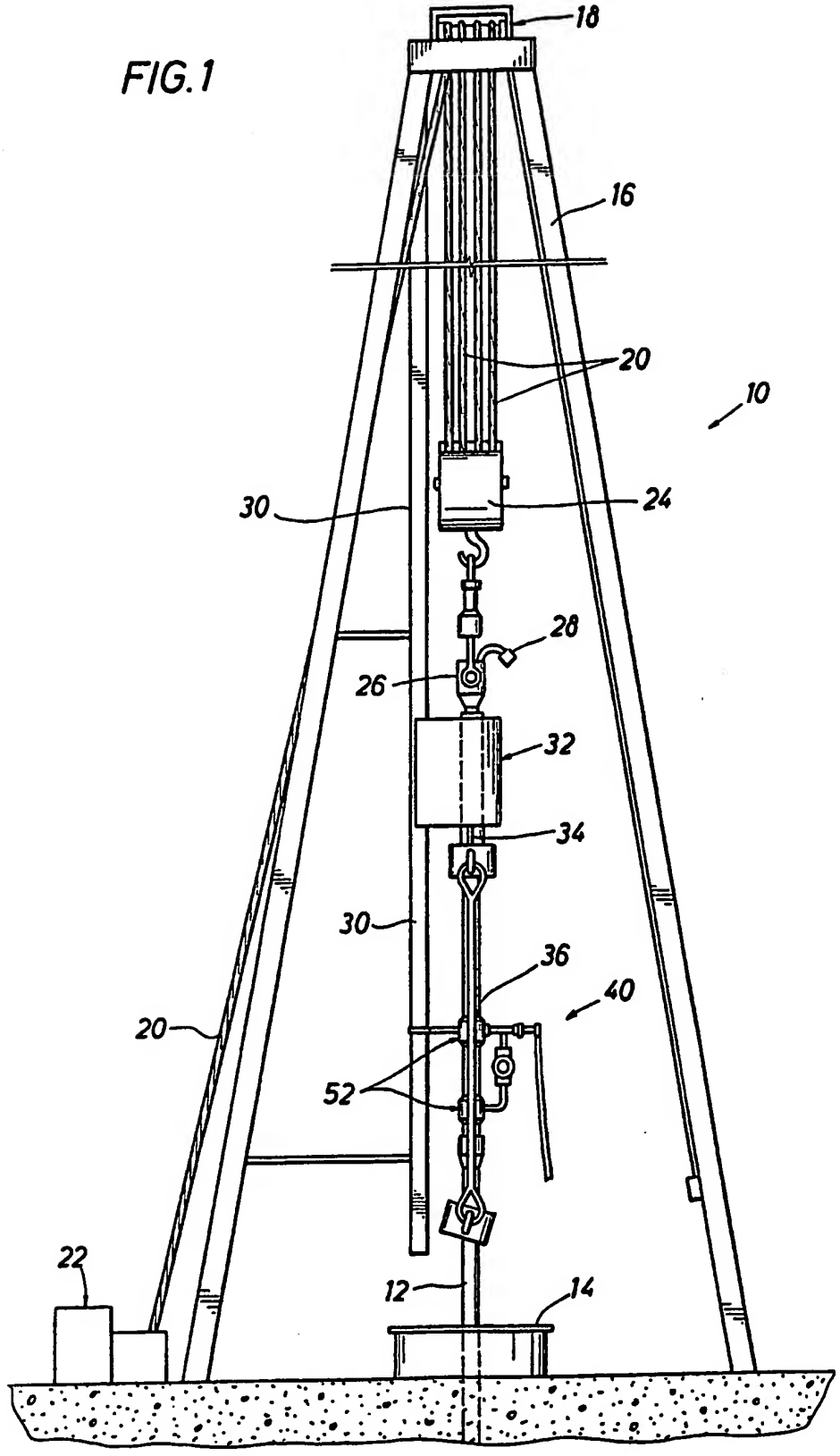
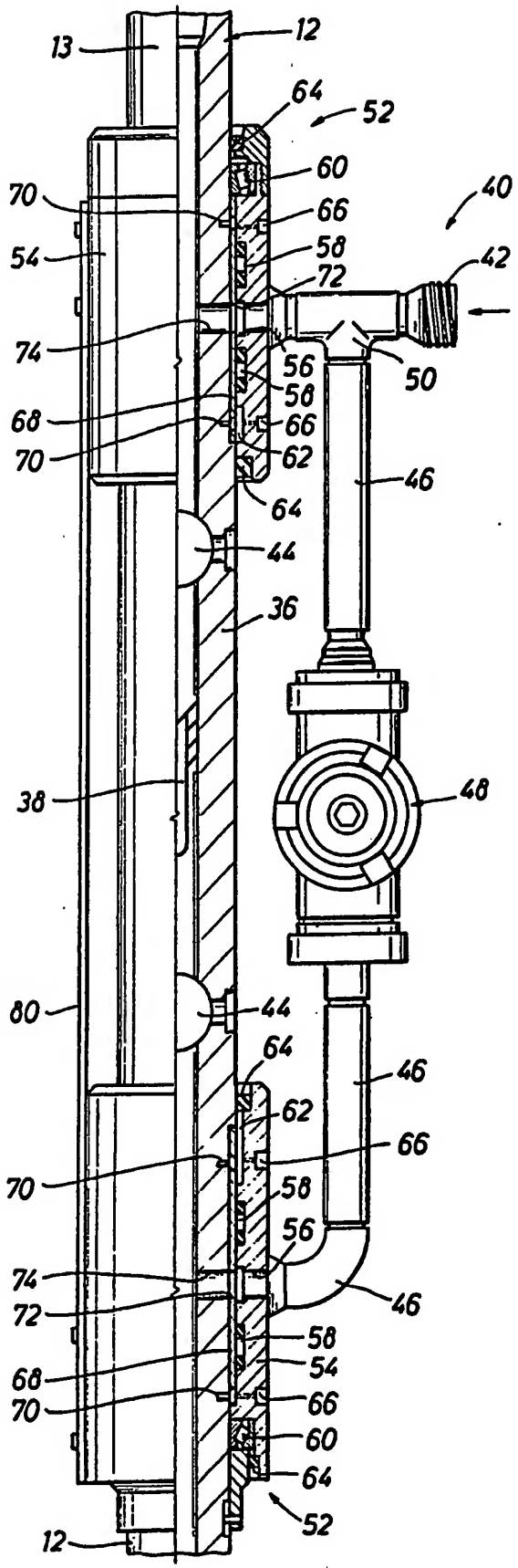


FIG. 2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TOP DRIVE CEMENTING MANIFOLD

Background Of The Invention

I. Field of the Invention

This invention relates to a manifold for the introduction of cement slurry as well as cementing plugs into a drill string rotatably driven by a top drive mechanism and, in particular, to a cementing manifold which is maintained stationary during rotation of the string yet facilitates the introduction of cement slurry and cementing plugs downhole.

II. Description of the Prior Art

Top drive power units are a well known method of working a well string within a wellbore. In the typical arrangement, the well string extending into the wellbore is connected at its upper end to a crown block which manipulates the well string vertically and a power unit which selectively rotates the well string. The crown block and power unit are supported by a mast assembly positioned over the wellbore. Through this arrangement, the well string may be manipulated both vertically and rotatably as drilling fluid is pumped through the string.

In order to complete the well, means are provided for conveying a cement slurry from an external supply source to the well string. In early top drive units, the cementing slurry was introduced directly through the top of the well string. This required interruption of cement pumping when cementing plugs were introduced into the well string. Also directing cement slurry through the top drive power unit severely limited the operating life of the power unit. In order to provide continuous flow of cement slurry, an inlet swivel was developed which facilitated the introduction of slurry through a side port below the power unit. This eliminated the need to direct the cement through the power unit extending its operating life. Additionally, various manifold arrangements have been developed for introducing one or more cementing plugs. These manifolds typically include one or more valves to create a plurality of fluid passageways through which the

cement slurry may flow. By placing the cementing plugs behind certain valves, the plugs can be strategically introduced into the wellbore as specific flow paths are opened. However, because of these flow paths prior known manifolds are fixedly attached to the well string causing them to rotate about the well string. Care must be taken to avoid the spinning manifold positioned just above the ground level. Additionally, the weight and force of the spinning manifold can create unwanted torque on the well string causing deflections and breakdowns.

Summary Of The Present Invention

The present invention overcomes the disadvantages of the prior known top drive cementing manifolds by incorporating swivel joints which secure the manifold to the well string while allowing the introduction of cement slurry directly through the manifold. The swivel joints allows the manifold to be maintained stationary as the well string is rotated.

The top drive cementing manifold of the present invention is connected to the well string by a plurality of swivels which allow fluid communication between the throughbore of the well string and the manifold. The manifold includes an inlet for introducing a cement slurry into the manifold and well string. A series of valves in the well string and manifold direct the cement slurry along the desired path. The swivel joints which facilitate independent rotation of the well string while maintaining the manifold stationary include an inlet port in communication with the manifold formed in the swivel housing. A swivel plate secured to the well string forms an annular groove in communication with the inlet port and a transverse port in the well string which communicates with the axial fluid passageway of the well string. As a result, as the well string rotates within the swivel joint fluid communication is maintained between the inlet port of the swivel housing and the transverse port of the well string through the annular groove. In order to maintain smooth rotation, the swivel housing incorporates a series of bearings as well as high

pressure seals to prevent cement slurry form flowing out of the desired fluid path and fouling the swivel joint. For added stability, a stabilizer bar interconnects the swivel joints.

The selectively operable valves of the manifold and well string direct cement slurry along the desired path while also facilitating deployment of cementing plugs. During initial completion operation, the valve in the manifold will be open while the valves of the well string remain closed. This will direct the cement from the inlet through the manifold and into the well string by passing the cement plugs. When it becomes necessary to deploy the cement plugs, the valve of the manifold is closed and the well string valves are opened diverting the cement slurry directly into the well string pushing the cement plug downhole. Throughout these operations, the well string can be rotated although the cementing manifold can be maintained stationary.

Other objects, features and advantages of the invention will be apparent from the following detailed description taken in connection with the accompanying drawings.

Brief Description Of The Drawing

The present invention will be more fully understood by reference to the following detailed description of a preferred embodiment of the present invention when read in conjunction with the accompanying drawing in which like reference characters refer to like parts throughout the view and in which:

FIGURE 1 is a perspective view of a top drive well rig having a cementing manifold embodying the present invention; and

FIGURE 2 is a partial cross-sectional view of the top drive cementing manifold arrangement for directing a cement slurry into the well string.

Detailed Description Of A Preferred Embodiment Of The Present Invention

Referring first to Figure 1, there is shown a top drive well rig 10 for manipulating a well string 12 into a wellbore 14. The

rig 10 typically includes a mast 16 having a crown block 18 mounted at its upper end which includes a plurality of rotatable pulleys for feeding a cable 20 between a draw works 22 and a traveling block 24. The traveling lock 24 is connected to the upper end of the well string 12 by a swivel 26 which allows rotation of the drill string 12 independent of the traveling block 24. Drilling fluid is fed directly into the drill string 12 through line 28 connected to a suitable source. A stationary guide rail 30 is mounted to the mast 16 and extends vertically from the top of the mast 16 downwardly nearly to ground level. A top drive power unit 32 which rotatably drives the well string 12 is slidably mounted to the guide rail 30 for longitudinal movement upon deployment of the well string 12. The power unit 32 includes a hollow stem 34 to which rotation is imparted. The hollow stem 34 is connected to the well string or hollow stem 36 of a cementing manifold 40 embodying the present invention. Thus, rotation will be imparted by the power unit 32 on the well string 12 through hollow stems 34 and 36. The cementing manifold 40 allows the selective introduction of a cement slurry and cementing plugs 38 even as the well string 12 is rotated as will be subsequently described.

Referring now to Figure 2, the cementing manifold 40 of the present invention allows both the introduction of a cement slurry through connector 42 and the independent rotation of the well string 12 while maintaining the manifold 40 stationary. Although the manifold 40 depicted in the drawing is a single bypass manifold, it is contemplated that the invention may incorporate a plurality of bypasses for deploying a plurality of cementing plugs 38 at various intervals yet incorporating the same concepts which allows the manifold to remain stationary during rotation of the well string.

The hollow stem 36 which parallels the manifold 40 includes connection means at its ends to allow connection to sections of drill pipe or the hollow stem 34 to form the rotatable well string 12. At least one valve 44 is positioned in the hollow stem 36 in order to direct fluid flow through the mandrel 40. As will be

subsequently described, upon opening the valves 44 fluid flow will be directed straight through the hollow stem 36 carrying the cement plug 38 into the wellbore. The mandrel 40 forms a fluid bypass around the valves 44 which begins above the valves 44 and rejoins the drill string 12 below the valves 44.

The bypass itself comprises piping 46 which forms a fluid passageway externally of the well string 12. A valve 48 may be included to selectively interrupt fluid flow through the bypass manifold 40. In a preferred embodiment, a T-connector 50 at the upper end of the manifold 40 allows fluid flow into the manifold 40 to come from either the well string 12 or the connector 42 for introduction of a cement slurry. Thus, the hose which delivers the cement slurry to the manifold 40 will be maintained stationary as the well string 12 is rotated.

Rotation of the well string 12 independent of the manifold 40 is made possible by the swivels 52 connecting the manifold 40 to the hollow stem 36 while providing fluid communication between the axial fluid passageway 13 of the well string 12 and the manifold 40. The swivels 52 employed in the manifold 40 are identical for each connection between the well string 12 and the manifold 40 -- only their placement along the hollow stem 36 differs. The swivels 52 comprise a swivel housing 54 to which the manifold piping 46 is fixedly connected and which allows rotation of the hollow stem 36 therein. The housing 54 includes an inlet port 56 in fluid communication with the manifold piping 46. The swivel housing 54 carries seal assemblies 58 positioned longitudinally above and below the inlet port 56 to prevent the flow of fluids into the housing 54. In a preferred embodiment of the swivels 52, roller bearings 60 are positioned between the housing 54 and the hollow stem 36 at the axial outer ends of the housings 54 to facilitate rotation of the well string 12 relative to the swivels 52. Similarly, at the axial inner end of the housings 54 between the swivel housing 54 and the hollow stem 36 is a plate bearing 62. At the outboard ends of the swivel housings 54 are wiper seals 64 which enclose the housing 54 to prevent contaminants from fouling

the bearings while creating a bearing chamber within the housing 54. Lubrication nipples 66 are provided for adding lubricant to the swivel housing, in particular the bearings 60,62 and the seals 58 to improve their operating life.

Secured to the hollow stem 36 within the swivel housing 54 is a tubular bearing 68. The tubular bearing 68 mounted to the hollow stem 36 using fasteners 70 and includes a circumferential slot 72 which, in conjunction with the exterior surface of the stem 36 forms a circumferential groove. The groove 72 is in continuous fluid communication with the port 56 of the swivel housing 54 even as the well string 12 rotates independent of the manifold 40. The hollow stem 36 includes a transverse port 74 which provides fluid communication between the axial fluid passageway 13 of the well string 12 and the circumferential groove 72 and in turn the inlet port 56. Although the drawing depicts the transverse port 74 as aligned with the port 56 this will occur only intermittently as the transverse port 74 rotates about the axis as the well string 12 rotates. Accordingly, the circumferential groove 72 provides continuous fluid communication between the ports 56 and 74.

In order to stabilize the manifold 40 during rotation of well string 12 a stabilizer bar 80 interconnecting the swivels 52 is secured to the exterior of the swivel housings 54.

The top drive cementing manifold 40 of the present invention facilitates the selective introduction of a cement slurry through the manifold 40 during initial completion operations and thereafter through the well string 12 to deploy a cementing plug 38. During the entire operation, the manifold 40 remains stationary as the well string 12 is rotated relative thereto. Initial drilling operations will require drilling fluid to be directed through the well string 12 into the wellbore 14. During this phase the valves 44 will be closed circulating the drilling fluid through the top drive power unit 32 and the manifold 40 bypassing the plug 38 in the hollow stem 36. If necessary the well string 12 may be rotated and reciprocated while such fluid circulation occurs, by raising and lowering the top drive 32 and the manifold 40 along the rail 30

and also affecting rotation of the well string 12 relative to the top drive 32 and the manifold 40. When it becomes necessary to conduct cementing operations in the well bore, cement may be introduced through inlet nozzle 42 into the manifold 40, through valve 48 and into the well string 12 through the bottom swivel 52. The cement slurry flowing through the swivels 52 will flow through port 56, into the circumferential groove 72 and then through port 74 into the axial passageway 13 of the well string 12. Since the valves 44 are closed, the cement slurry will be prevented from flowing through the hollow stem 36.

After a desired quantity of cement is discharged into the well bore, the valves 44 may be opened and valve 48 of the manifold 40 closed such that when additional cement is pumped into the manifold 40 it will be diverted through the upper swivel 52 into the hollow stem 36 to carry the cementing plug 38 into the well string 12. During the entire operation, the well string may be reciprocated and rotated although the manifold 40 will not rotate with the well string 12.

~~The foregoing detailed description has been given for~~ clearness of understanding only and ~~no~~ unnecessary limitations should be understood ~~therefrom~~ as some modifications will be obvious to those ~~skilled~~ int eh art without departing from the ~~scope and spirit of the appended claims~~.

~~What is claimed is:~~

CLAIMS

1. A manifold assembly adapted to be connected between a hollow rotatable stem extending through a top drive power unit and a well string extending into a wellbore, said manifold assembly facilitating fluid circulation into the well string as the well string is selectively rotated in the well bore, said manifold assembly comprising:

a rotatable manifold stem having an axial fluid passageway and at least two longitudinally spaced transverse ports providing fluid communication between said axial fluid passageway and the exterior of said manifold stem, said manifold stem including means for connecting said manifold assembly to the hollow rotatable stem of the top drive power unit and to the well string such that said manifold stem is selectively rotatable with the well string;

a plurality of swivels longitudinally spaced along said manifold stem corresponding to said spaced transverse ports, said swivels including a tubular swivel housing having said manifold stem extending therethrough, said swivel housings having a lateral inlet port; and

a bypass manifold fixedly connected to each of said swivels, said manifold including a fluid passageway in direct fluid communication with said inlet ports of said swivel housings and a connector nozzle for circulating fluids directly into said bypass manifold;

said manifold stem rotatable relative to said swivels and bypass manifold along with the well string as said bypass manifold remains stationary whereby fluid communication is continuously maintained between said axial fluid passageway of said manifold stem and said fluid passageway of said bypass manifold through said transverse ports and inlet ports associated with said swivels.

2. The manifold assembly as defined in claim 1 wherein said manifold stem includes at least one valve means positioned between

CLAIMS

1. A manifold assembly adapted to be connected between a hollow rotatable stem extending through a top drive power unit and a well string extending into a wellbore, said manifold assembly facilitating fluid circulation into the well string as the well string is selectively rotated in the well bore, said manifold assembly comprising:

a rotatable manifold stem having an axial fluid passageway and at least two longitudinally spaced transverse ports providing fluid communication between said axial fluid passageway and the exterior of said manifold stem, said manifold stem including means for connecting said manifold assembly to the hollow rotatable stem of the top drive power unit and to the well string such that said manifold stem is selectively rotatable with the well string;

a plurality of swivels longitudinally spaced along said manifold stem corresponding to said spaced transverse ports, said swivels including a tubular swivel housing having said manifold stem extending therethrough, said swivel housings having a lateral inlet port; and

a bypass manifold fixedly connected to each of said swivels, said manifold including a fluid passageway in direct fluid communication with said inlet ports of said swivel housings and a connector nozzle for circulating fluids directly into said bypass manifold;

said manifold stem rotatable relative to said swivels and bypass manifold along with the well string as said bypass manifold remains stationary whereby fluid communication is continuously maintained between said axial fluid passageway of said manifold stem and said fluid passageway of said bypass manifold through said transverse ports and inlet ports associated with said swivels.

2. The manifold assembly as defined in claim 1 wherein said manifold stem includes at least one valve means positioned between

swivels for selectively interrupting fluid flow through said axial fluid passageway diverting fluid flow through said bypass manifold.

3. The manifold assembly as defined in claim 1 and further comprising at least two tubular bearing members fixedly secured to said manifold stem proximate each of said transverse ports, said tubular bearing member including a circumferential slot aligned with said port, said slot forming a circumferential groove on said manifold stem to maintain continuous fluid communication between said transverse ports and said inlet ports of said swivel housings as said manifold stem rotates relative to said swivels.

4. The manifold assembly as defined in claim 3 wherein said swivels include upper and lower seal assemblies disposed within said swivel housings longitudinally above and below said inlet port respectively, said seal assemblies preventing fluid flow longitudinally within said swivel housings.

5. The manifold assembly as defined in claim 3 wherein said swivels include at least one bearing disposed within said swivel housing to facilitate rotation of said manifold stem relative to said swivel housing.

6. The manifold assembly as defined in claim 3 wherein said connector nozzle of said bypass manifold is connected to means for supplying a cement slurry to said manifold assembly such that cement slurry may be selectively circulated into the well string through said bypass manifold and said axial passageway of said manifold stem.

7. A manifold assembly adapted to be connected between a hollow rotatable stem extending through a top drive power unit and a well string extending into a wellbore, said manifold assembly facilitating fluid circulation into the well string as the well

string is selectively rotated in the well bore, said manifold assembly comprising:

a rotatable manifold stem having an axial fluid passageway and means for connecting said manifold stem to the hollow rotatable stem of the top drive power unit and to the well string such that said manifold stem is selectively rotatable with the well string;

a pair of swivels longitudinally spaced along said manifold stem, said swivels including a tubular swivel housing having said manifold stem extending threrethrough, said swivel housing having a lateral inlet port in continuous fluid communication with said axial fluid passageway of said manifold stem;

a bypass manifold fixedly connected to both said swivels in fluid communication with said inlet port of said swivel housing whereby continuous fluid communication is maintained between said axial fluid passageway of said manifold stem and said bypass manifold as the well string is rotated independent of said bypass manifold and swivels;

a connector nozzle formed in said bypass manifold for circulating fluids directly into said bypass manifold; and

valve means within said manifold stem between said swivels for selectively interrupting fluid flow through said axial fluid passageway diverting fluid flow through said bypass manifold.

8. The manifold assembly as defined in claim 7 where said manifold stem includes a pair of longitudinally spaced transverse ports providing fluid communication between said axial fluid passageway and the exterior of said manifold stem.

9. The manifold assembly as defined in claim 8 and further comprising a pair of tubular bearing members fixedly secured to said manifold stem coaxial with said swivel housings, said tubular bearing members having a circumferential slot forming a circumferential groove on said manifold stem aligned with said transverse ports of said manifold stem and said inlet port of said swivel housings to maintain continuous fluid communication

string is selectively rotated in the well bore, said manifold assembly comprising:

a rotatable manifold stem having an axial fluid passageway and means for connecting said manifold stem to the hollow rotatable stem of the top drive power unit and to the well string such that said manifold stem is selectively rotatable with the well string;

a pair of swivels longitudinally spaced along said manifold stem, said swivels including a tubular swivel housing having said manifold stem extending threrethrough, said swivel housing having a lateral inlet port in continuous fluid communication with said axial fluid passageway of said manifold stem;

a bypass manifold fixedly connected to both said swivels in fluid communication with said inlet port of said swivel housing whereby continuous fluid communication is maintained between said axial fluid passageway of said manifold stem and said bypass manifold as the well string is rotated independent of said bypass manifold and swivels;

a connector nozzle formed in said bypass manifold for circulating fluids directly into said bypass manifold; and

valve means within said manifold stem between said swivels for selectively interrupting fluid flow through said axial fluid passageway diverting fluid flow through said bypass manifold.

8. The manifold assembly as defined in claim 7 where said manifold stem includes a pair of longitudinally spaced transverse ports providing fluid communication between said axial fluid passageway and the exterior of said manifold stem.

9. The manifold assembly as defined in claim 8 and further comprising a pair of tubular bearing members fixedly secured to said manifold stem coaxial with said swivel housings, said tubular bearing members having a circumferential slot forming a circumferential groove on said manifold stem aligned with said transverse ports of said manifold stem and said inlet port of said swivel housings to maintain continuous fluid communication

therebetween as said manifold stem rotates within said swivel housings.

10. The manifold assembly as defined in claim 9 wherein said swivel housings include upper and lower seal assemblies positioned longitudinally above and below said circumferential groove to prevent fluid leakage into said swivel housing from said inlet port.

11. The manifold assembly as defined in claim 7 wherein said valve means comprises a pair of valves mounted within said axial passageway of said manifold stem.

12. The manifold assembly as defined in claim 11 wherein said bypass manifold includes a valve for selectively interrupting fluid flow through said bypass manifold diverting fluid flow into said axial passageway of said manifold stem.

13. The manifold assembly as defined in claim 11 wherein a cementing plug is positioned within said axial fluid passageway between said valves of said manifold stem.

14. A manifold assembly adapted to be connected between a hollow rotatable stem extending through a top drive power unit and a well string extending into a wellbore, said manifold assembly facilitating fluid circulation and cementing operations as the well string is selectively rotated in the well bore, said manifold assembly comprising:

a rotatable manifold stem having an axial fluid passageway and means for connecting said manifold stem to the hollow rotatable stem of the top drive power unit and to the well string such that fluid may be circulated through the hollow rotatable stem and said manifold stem into the well string as said manifold stem is selectively rotated with the well string;

an upper and a lower swivel longitudinally spaced along said manifold stem, said swivels including a tubular swivel housing having said manifold stem extending therethrough, said upper and lower swivels mounted to said manifold stem proximate upper and lower transverse ports formed in said manifold stem in fluid communication with said axial fluid passageway of said manifold stem, said swivel housings including:

a lateral inlet port in continuous fluid communication with said transverse port of said manifold stem;

upper and lower seal assemblies positioned longitudinally above and below said lateral inlet port to prevent fluid leakage into said swivel housing from said inlet port;

bearing means for rotation of said manifold stem relative to said swivel housing; and

seal means disposed at remote ends of said swivel housing forming a lubricant chamber within said swivel housing;

tubular bearing members fixedly secured to said manifold stem coaxial with said swivel housings, said tubular bearing members having a circumferential groove aligned with said transverse ports of said manifold stem and said inlet port of said swivel housing to maintain continuous fluid communication therebetween as said manifold stem rotates within said swivel housings;

a bypass manifold fixedly connected to both said upper and lower swivels for fluid communication therebetween, said bypass manifold in fluid communication with said inlet ports of said upper and lower swivels, said bypass manifold including a connector for circulating cementing fluids directly into said bypass manifold;

at least one valve disposed within said manifold stem between said upper and lower swivels for selectively interrupting fluid flow through said axial fluid passageway diverting fluid flow through said bypass manifold.

15. A well string manifold assembly substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

Patents Act 1977 Examiner's report to the Comptroller under Section 17 -14- (The Search report)	Application number GB 9400356.3
Relevant Technical Fields (i) UK Cl (Ed.M) E1F (FJT) (ii) Int Cl (Ed.5) E21B	Search Examiner D J HARRISON
	Date of completion of Search 5 APRIL 1994
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii)	Documents considered relevant following a search in respect of Claims :- 1 TO 15

Categories of documents

X:	Document indicating lack of novelty or of inventive step.	P:	Document published on or after the declared priority date but before the filing date of the present application.
Y:	Document indicating lack of inventive step if combined with one or more other documents of the same category.	E:	Patent document published on or after, but with priority date earlier than, the filing date of the present application.
A:	Document indicating technological background and/or state of the art.	&:	Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
X,P	EP 0556007 A1	(HALLIBURTON COMPANY) 18 August 1993 whole document	1,3,4,6
X,P	EP 0556006 A1	(HALLIBURTON COMPANY) 18 August 1993 whole document	1,3,4,6

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